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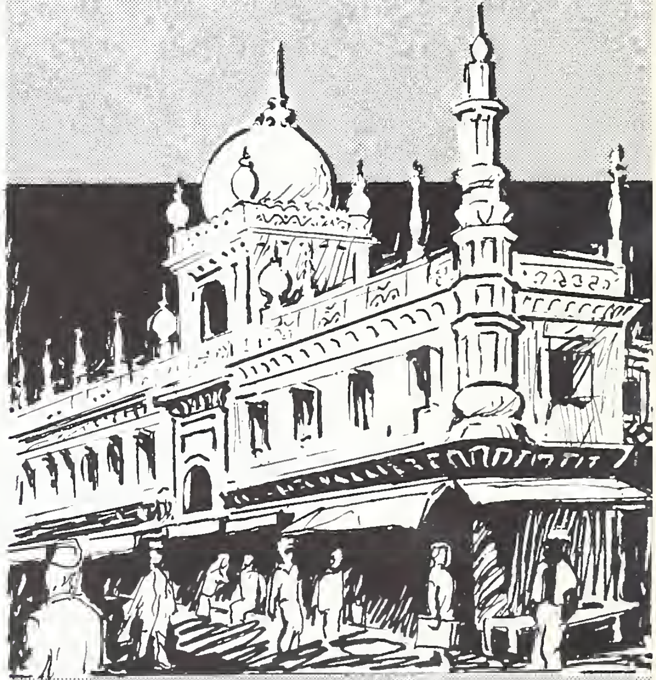
THE FATS AND OILS ECONOMY OF India



Foreign Agricultural Service

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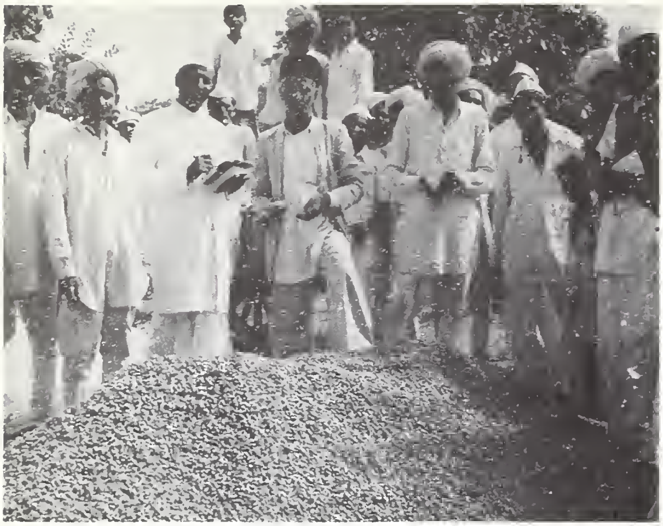

In Bombay--India's largest producing State--peanuts are heaped on the ground and sold through a Commission agent. Most of India's peanuts are crushed for use as oil.

Peanuts are bagged prior to removal from the sale site. Nearly all of India's output is used in the domestic market.

The next step is to weigh the bagged peanuts on primitive bar scales.

THE FATS AND OILS ECONOMY OF INDIA

By Edgar L. Burtis and Edward Quinones*
Fats and Oils Division

Summary

India has become a small net importer of vegetable oils in the last few years, reversing its prewar position as a major world exporter. This has come about despite the fact that India is the world's fourth largest producer of fats and oils. Sharply rising consumption has exceeded the rate of increase in production. The rising demand for oils in turn reflects India's rapidly expanding population and, in the 1950's a moderate increase in per capita income.

Demand for oils will continue to rise in the 1960's, and it is problematical whether production will be able to keep pace. Only in years of exceptionally good crops will India be able to export edible oils without reducing the small per capita supplies available to its own population. Exports of nonfood oils will probably continue at recent levels.

Oilseed production is expected to total 8.35 million long tons1/ by 1966, an increase of about 37 percent over the 1957 and 1958 average. This faster pace than that of the last 10 years is expected because of various river valley projects initiated in 1958. Large areas of peanuts and rapeseed-mustardseed are expected to be irrigated, which should materially increase yields per acre. Depending upon the success of the river valley projects, production may exceed the forecasted 8.35 million long tons.

With the increase in oilseed supplies and crushing of a larger percentage of the cottonseed crop, vegetable oil production should rise by 1966 (the end of India's Third Five Year Plan) to about 2.4 million tons, 700,000 more than the average for 1957-58. This large increase in supply will only keep up with population increases and add about 1.1 pounds of oil per capita.

The population of India is rising at an increasing rate and will total about 480 million by 1966. Demand for oils is also going up and will increase further with rises in income. The demand for vegetable oils will be further increased with a decrease in available per capita supplies of animal fats, i.e., ghee (clarified butter) and butter. Unless prices are allowed to rise materially by 1966, India's net import requirements may become substantial.

The Indian Government since 1950 has actively controlled foreign trade in oilseeds and oilseed products. With minor exceptions, oilseed exports have been banned. Exports of oils and oilcake and meal have been regulated with a view to maintaining domestic supplies. In mid-1958, however, policy shifted toward placing more emphasis on exports as a means of earning foreign exchange. Under this policy, exports of oilcake have risen sharply, but prices of oils in India have been too high to permit much increase in oil exports.

The major sources of edible oils in India are peanuts, rapeseed and mustardseed, sesameseed, copra, and linseed (flaxseed). Ghee (clarified

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* Mr. Burtis, now a member of the Food and Agriculture Organization, Rome, was chief, Foreign Competition Branch, Fats and Oils Division, when he made this study. 1/ All tons in this study are long tons, 2,240 pounds.

butter) and butter constitute about a quarter of India's total consumption of fats and oils.

The acreage and production of peanuts have been increasing for many years. Since peanuts are considerably more profitable than grain sorghum and millets, which are the principal crops in most peanut-producing areas, a continuing rise in peanut acreage is likely, particularly if the demand for fats and oils continues to rise as in recent years. Other oilseed crops have not shown the same expansion over the decades as peanuts, but rapeseed and mustardseed have expanded considerably since the partition of India in 1947. Oilseed yields per acre have declined markedly for a long time, but in recent years peanuts and castorbeans have had a modest recovery. Ghee and butter production will probably not rise materially since milk production increases will probably be consumed fresh.

Castorbeans are a principal source of inedible oil in India, and most of the castor oil produced is sold for export. Some linseed oil is exported too, but most of it is used domestically and export demand must compete for the supply. In India, linseed is both a food and industrial oil. Coconut oil (from copra) has dual purposes also, and is used for soap or consumed as food. From 15 to 20 percent of the copra used in India is imported. A moderate tonnage of palm oil is imported for soap manufacture.

Oilcake production in 1958-59 totaled about 3.0 million tons. Most of it is used as livestock feed or fertilizer. About 8 percent was exported in 1958, and since prices in Bombay have been substantially lower in most recent years than in European ports, Indian oilcake exports probably would increase substantially if controls were eased further.

The per capita consumption of fats and oils in India, at about 12.5 pounds, is one of the lowest in the world. One to two pounds per person are used for soap, paints, and other nonfoods and 10 to 11 pounds are used for food purposes. This compares with 20 pounds for nonfood products and about 45 pounds for food in the United States. With the per capita consumption of fats and oils at such low levels, Indian consumers tend to increase their consumption in direct proportion to increases in their income.

Production

Upward Trend in Acreage and Production

The acreage devoted to annual oilseed crops in India has nearly doubled since 1910-19 and is now around 31 million acres, exclusive of cotton. This is approximately the same as in the United States. The whole increase in India has been in peanuts; the acreage of other oilseeds has not changed much. In 1910-19, the acreage devoted to peanuts accounted for only 8 percent of the total oilseed acreage but in recent years it has approached 50 percent.

The area planted to the five major annual oilseeds in recent years (peanuts, rape-mustardseed, sesame, linseed, castor) has fluctuated around 9 percent of the total acreage in crops in India and around 20 percent of crop acreage in the States of Bombay and Uttar Pradesh. These percentages are similar to those in the United States: 8 percent for the country as a whole (excluding cotton) and about 20 percent in Illinois, the leading oilseed producing State.

TABLE 1.--Major annual oilseeds: Acreage, yield per acre, and production, averages 1910-54, annual 1955-59

Item	Average					1955	1956	1957	1958	1959
	1910-19	1920-29	1930-39	1940-49 1/	1950-54					
	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres
ACREAGE 2/										
Peanuts............	1,431	3,001	6,515	9,211	11,086	13,693	12,685	13,450	14,876	14,481
Mustard and rapeseed	6,366	6,107	6,140	5,361	5,316	6,027	6,316	6,311	5,979	6,288
Sesame seed.........	4,955	4,765	5,201	4,507	5,733	6,490	5,667	5,446	5,171	5,332
Linseed.............	3,513	3,469	3,869	3,878	3,505	3,362	3,781	4,156	3,129	3,708
Castor beans........	3/ 1,239	4/ 1,320	1,413	1,292	1,388	1,370	1,405	1,415	1,184	1,193
Total.............	17,504	18,662	23,138	24,249	27,028	30,942	29,854	30,778	30,339	31,002
YIELD PER ACRE	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Peanuts............	1,094	1,054	921	819	662	675	671	699	668	745
Mustard and rapeseed	404	397	380	395	352	379	300	364	346	381
Sesame seed.........	221	236	218	205	182	205	182	182	153	207
Linseed.............	299	285	275	248	238	256	245	207	178	260
Castor beans........	199	199	197	205	174	199	198	196	168	208
	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons
PRODUCTION 2/										
Peanuts (unshelled).	702	1,398	2,681	3,354	3,244	4,128	3,801	4,200	4,436	4,816
Mustard and rapeseed	1,165	1,081	1,040	946	835	1,021	846	1,026	923	1,069
Sesame seed.........	488	501	507	413	466	593	460	442	354	493
Linseed.............	472	438	474	430	372	384	414	384	249	430
Castor beans........	3/ 110	4/ 118	124	117	108	122	124	124	89	111
Total.............	2,937	3,536	4,826	5,260	5,025	6,248	5,645	6,176	6,051	6,919

1/ Beginning 1945, data exclude the area now constituting Pakistan. 2/ Years for acreage and production refer to crop years ending in year shown. 3/ Average 1915-19, Madras and Hyderabad only. Data for Hyderabad 1916-17 are not available. 4/ 1920-24 Madras and Hyderabad only; United Provinces, Central Provinces and Bihar estimated in 1925. Official Indian statistics and report of the Attache.

Except for castorbeans, oilseed yields per acre in India have shown a marked downward trend over the decades. Gradual exhaustion of the soil apparently has been a major factor affecting oilseed yields. The decline in peanut yields, however, is also traceable to the expansion of peanut acreage from the original districts in Madras State to areas where rainfall and soils are less suited to the crop. The relative stability of castor yields probably results from the fact that castor has always been planted mainly on poor soils. Had yields per acre of all oilseeds been maintained at the 1910-10 average, oilseed production in 1958-59 would have been 9.2 million tons, nearly 40 percent higher than actual production.

Production of oilseeds in India has more than doubled since 1910-19. In the 1958-59 crop year, production of the five major annual oilseeds totaled about 6.9 million long tons. This was an exceptionally good year, but even the preceding year, at 6.1 million tons, was better than double the 1910-19 average. The reason that production increased faster than acreage despite declining yields per acre is that the expansion has been almost entirely in peanuts, which have much higher yields per acre than the other crops. The peanut crop in 1958-59 was nearly seven times as large as in the 1910 decade, but total production of the other oilseeds did not increase.

Climate Tropical

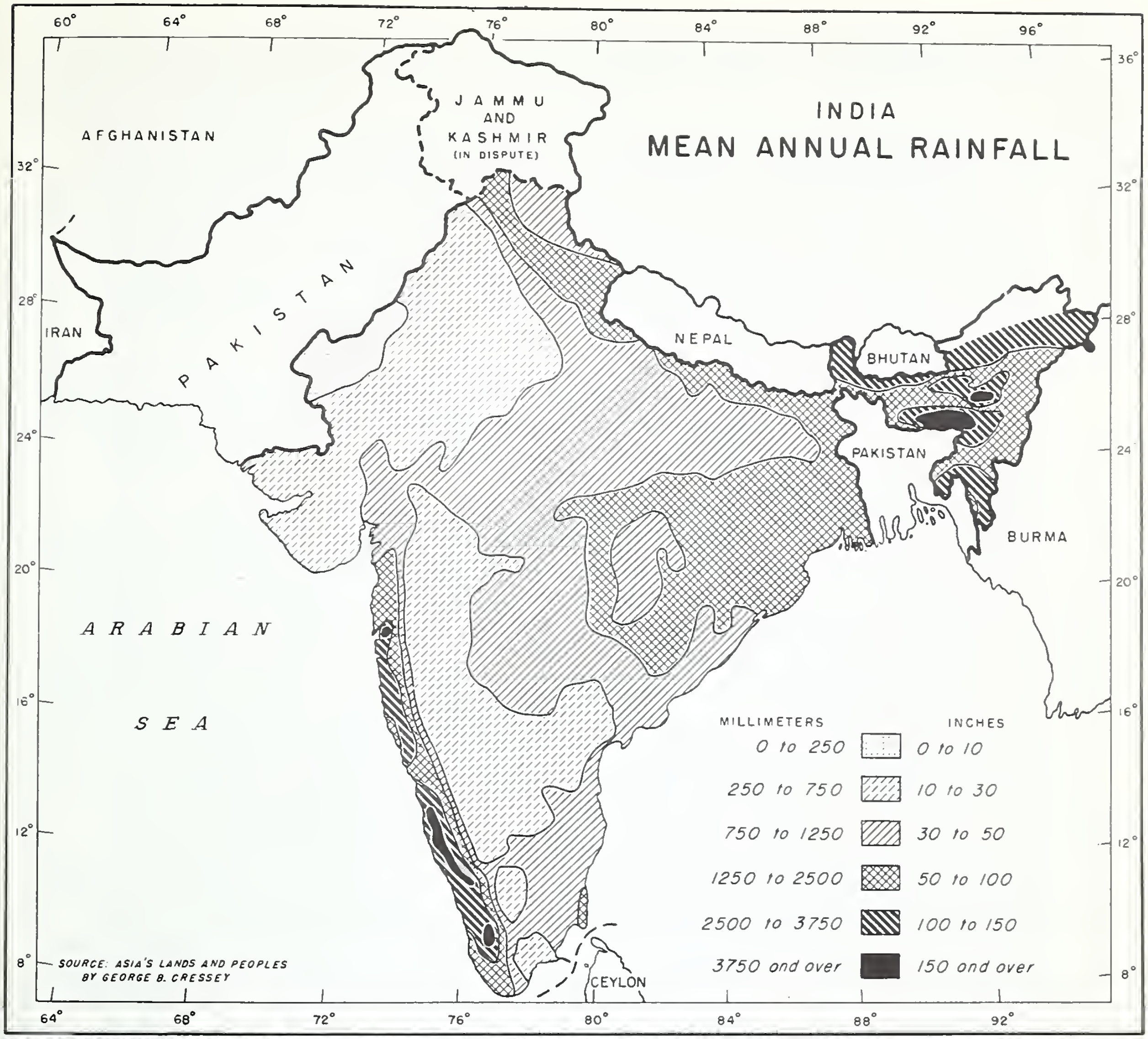
Even though one-third of India is situated north of the Tropic of Cancer, all parts of the country except the high elevations have a tropical climate. This is largely due to the Himalayan Mountains, which act as a barrier to the northern cold winds.

The monsoons are the key to the seasons in India. Most of the year's rain is associated with the southwest monsoon, which blows in from the Indian Ocean. This begins in May in southern India and by mid-June it influences practically the whole country. In the Ganges Basin, a branch of the monsoon flows in from a southeasterly direction. The monsoon begins to retreat from northern India in September and disappears from the country by the end of October. Crops planted during the southwest monsoon or summer months, are called kharif crops and this is the main crop season.

From November to April, most of India is dry. Cool weather prevails in December-February. From March until the onset of the southwest monsoon the temperature rises, with daily maximums finally reaching well over 100° F. in interior low-altitude areas of the country. Northeasterly winds usually bring moderate rains in the autumn to the east coast of southern India, including districts well inland in Madras State. In northern India, there are usually moderate rains in the late fall and early winter months. Crops raised in the relatively dry, or winter, months are known as rabi crops.

In extreme southwest India, in a narrow strip between the coast and the mountains, rains extend through most of the year, mainly because of the early arrival and late departure of the southwest monsoon.

Large areas of India, however, are relatively dry. Mountains along the western coast precipitate much of the moisture from the southwest monsoon. East of these mountains is a semiarid plateau, which supports a large acreage of oilseeds, particularly peanuts and castorbeans. The average annual rainfall over much of this area is below the optimum for these crops. Wide year-to-year and seasonal fluctuations in the rainfall are reflected in wide variations in the yield per acre.



SOURCE: ASIA'S LANDS AND PEOPLES BY GEORGE B. CRESSEY

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Soils Exhausted

Soils are a limiting factor on oilseed production in India. Generally speaking, the soils are in poor condition as a result of leaching, termite action, and the lack of restorative crops, organic matter, and fertilizers. Some areas have been producing for many centuries. Although there are many cattle in India, dung is mainly used as fuel and is not often applied on the fields. Besides this, overgrazing and monoculture have accelerated soil erosion in many areas.

India hopes to increase oilseed yields per acre, which are among the lowest in the world, but the early realization of significant increases is doubtful. India has almost tripled its chemical fertilizer consumption from 1951-52 to 1958-59, but the increases are small when compared with needs, and first priorities for fertilizer application by the state governments are usually given to sugarcane, rice, and other grains.

Peanuts

Strong Uptrend in Acreage and Production.--India is the world's leading peanut producer. Its acreage of peanuts has expanded steadily for 60 years or more. At the turn of the century only 300,000 acres were planted to peanuts, and the crop was important only in an area near the city of Madras. Major areas of production are now to be found in many parts of peninsular India. In very recent years, there has been a small but rapidly increasing acreage in Uttar Pradesh and the Punjab. By 1958-59, India had 14.5 million acres of peanuts, equal to 47 percent of the total acreage in the major annual oilseed crops. Peanuts now account for 4 percent of the total crop acreage in India and stand in seventh place following rice (24 percent), pulses (17 percent), jowar (13 percent), wheat (9 percent), bajra (8 percent), and cotton (6 percent).

The production of peanuts in 1958-59 set an alltime high of 4.8 million long tons (unshelled basis) compared with the 1910-19 average of 0.7 million tons. Yields per acre in 1958-59 were 745 pounds, the highest since 770 pounds were produced in 1949-50.

Climate Generally Favorable but Capricious.--Peanut culture is well suited to India's monsoon climate. The rainy hot growing season is followed by dry weather which permits harvesting and drying of the vines. A large part of the peanut area, however, has an average rainfall below the optimum needed for maximum production and the vagaries of the monsoons often bring serious droughts. Weather at planting time is an important factor affecting acreage, dry weather making it difficult for farmers to prepare the soil and plant the crop. On the other hand, late rains sometimes prevent harvesting at the proper time or damage the peanuts during the curing period.

The main kharif, or summer, crop of peanuts is planted in April or May and harvested mostly from September to December. In southeastern India, where there are some autumn and winter rains, a second, or rabi, crop is raised. The harvest period for this crop extends from May to July.

Peanuts a Profitable Crop.--Probably the principal reason for the long-continued uptrend in peanut acreage is the relative profitableness of the crop. Costs of growing peanuts are not greatly higher than those for other nonirrigated crops, and the gross return per acre is higher. For example, in Bombay State in the 3 crop years 1952-53/1954-55, the gross return per acre from peanuts averaged $19.37 compared with $11.70 from jowar (grain sorghum), the most competitive crop with peanuts. Some other competing crops and returns were bajra (spiked millet) with $6.99 per acre; sesame with $11.90, corn with $11.54 and ragi (a millet) with $17.60. In Madras State, the situation during the same period was similar; peanuts led all other crops in returns per acre: Peanuts $38.95, jowar $20.72, bajra $14.46, sesame $17.60, and ragi $27.82.

Fluctuations in the price of peanuts apparently affect peanut acreage. A statistical analysis for the period 1929-30/1942-43 indicates that farmers tended to expand or contract peanut acreage in response to the increase or decrease in the preceding crop year in the ratio of the price of peanuts to the price of sorghum and millet. 2/ This relationship also appears to have held in the late 1950's, although there are not yet data for enough years to establish the relationship statistically. In the intervening years there was no consistent relationship between peanut acreage and prices. This may

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2/ Data and details of the analysis are given in Appendix 1.

have been due to a rapid general price inflation during the 1940's, distortion of normal economic relationships by price controls, rationing of food grains (including grain sorghum and millets), and "Grow-More-Food" campaigns which emphasized grain.

Further Gradual Increase Likely in Acreage and Production.--Despite the wide margins of profitability of peanuts over other crops, increases in acreage have been relatively slow. An important factor that must be kept in mind when considering competition for the land in India, is that a large part of the economy operates on other than price considerations. Grain sorghum and millets continue to be grown on a large scale despite their relatively low value per acre because farmers depend heavily on them for food. Most villages in India are isolated. There is only an elementary system of rural roads, and transportation costs from rail centers are high. Villages have always been largely self-sufficient, and the farmers cannot count on being able to purchase food at reasonable prices and hence must raise the bulk of their own food needs. As the rural areas become less isolated and more integrated into the web of commercial transactions, producers will have less need to produce sorghum and millets for their own use and the attractiveness of peanuts as a source of cash probably will increase.

Indian authorities have repeatedly pointed out how low oilseed yields per acre are. For example, from 1955 to 1958 peanut yields in India averaged 678 pounds, compared with 1,053 pounds in the United States and 1,014 pounds in Argentina during the same period. It is apparent that production would be materially increased if per acre yields were brought only part of the way toward yields in other major producing countries. The Central and State Governments are trying in many ways to raise per acre yields. Agricultural experiment stations have developed improved varieties and strains of peanuts, and in some States the improved seed is multiplied through arrangements with private producers and then becomes available for distribution. Experiment stations have also determined what the best cultural methods are. Agricultural Extension Services are being developed and strengthened to get information to the farmers, and the community development programs are being used as channels for disseminating information. In 1946, a Central Oilseeds Committee was established, and in 1956 its responsibilities and authority were increased and headquarters were moved to Hyderabad. This group keeps all official oilseed activities (except for coconuts) under review, and has funds available for grants for specific projects to stimulate research, extension work, direct services to farmers, and other efforts aimed at improving production of oilseeds and oils.

In 1958 river valley irrigation projects were initiated which will bring large areas of peanuts and rape-mustard under irrigation. These projects should have the result of raising yields per acre; results will be realized toward the end of India's third Five Year Plan.

Efforts to improve yields, however, face difficult obstacles. Illiteracy and the poverty of farmers hinder the spread of improved techniques, and there are other problems, like land tenure. Even very small capital expenditures are likely to be beyond the reach of most farmers in a country where the per capita income is less than $60 per year. The exhaustion of the soil is another severe handicap.

Rapeseed and Mustardseed

Recent Uptrend in Acreage and Production.--Several species of the Brassica family, some of which are popularly called rapeseed and some mustardseed, collectively compose the second most important oil crop in India. They do not thrive in hot wet weather and are raised as a winter crop in northern India. About half of the acreage is in Uttar Pradesh and the rest is in the Punjab, Rajasthan, Madhya Pradesh, Assam, West Bengal, and Bihar. From 1900 to 1945 the acreage averaged 6 million acres and fluctuated between 5 million and 7 million acres. Almost 2 million of these acres were in what is now Pakistan. Since the partition of India in 1947, the acreage in India as presently constituted has shown a rising trend and averaged 6.2 million acres from 1956-57 to 1958-59.

Although rape and mustardseed account for 20 percent of the oilseed acreage, they contribute only 13 to 15 percent of the total oilseed production. Yields per acre are about half as high as for peanuts. India is the world's second largest producer of rapeseed and mustardseed, but it has the lowest yield per acre of the seven major producing countries.

Profitability Less Than for Wheat.--Scattered information indicates that rape and mustardseed have a considerably smaller value per acre than wheat. Evidence is mixed regarding their profitability in relation to other nonirrigated crops. In Bihar, in 1937-38 and 1938-39 the gross return per acre from wheat averaged 35 percent more than from rape and mustard, but these returned 7 percent more than gram and 20 percent more than barley. In Uttar Pradesh in 1952-53 the gross return per acre from wheat was over 50 percent more than from rapeseed, barley returned nearly 20 percent more, and gram was about equal with rapeseed and mustardseed.

Nevertheless, the record of rising acreage since 1947 implies that there are factors which make rape and mustardseed relatively attractive to farmers. Strong demand for edible oils and consumers' preference in northern India for rape and mustard oils are price-supporting factors for the future. Further acreage increases are likely in the next few years.

Sesame

No Long-Term Trend in Acreage or Production.--India leads the world in acreage in sesame, with 44 percent of the total. However, only 26 percent of world production is contributed by India. During the quinquennium 1951-55 the average for India was 185 pounds per acre and for the world, 316 pounds.

For a brief period after the war, up to 1955-56, sesame was the No. 2 crop in oilseed acreage in India, but since then it has dropped to third place. In 1958-59, sesame constituted about 16 percent of the total oilseed acreage and contributed 6 percent of the oilseed production. There is no long-term trend in sesame acreage.

Sesame is mostly raised during the summer monsoon season and does well in the drier northern or middle India States. The States of Uttar Pradesh, Rajasthan, and Madhya Pradesh produce over half of the sesameseed; the remainder of the crop is raised mostly in Bombay and Andhra Pradesh.

Linseed

Yields Per Acre and Production Declining.--India ranks third in the world in the acreage of linseed (flaxseed), contributing 20 percent. Linseed acreage constitutes 11 percent of the total Indian oilseed acreage compared with 22 percent in 1910-19. This reflects the expansion of peanuts; linseed acreage has shown no trend. Yields per acre and production of linseed have been decreasing over a long period of time. Production for the quinquennial, 1954-55 to 1958-59, is estimated at 372,200 tons, compared with the 1910-19 average of 470,000 tons.

Linseed is a winter crop and is sown in August-November and harvested in January-March. It depends on the moisture retained in the soil from the summer monsoon and the light to moderate rains received in the late fall and early winter.

The plant is grown on a variety of soils. In Madhya Pradesh and Bombay, which have heavy moisture-retaining soils, a deep-rooted, rapid-growing type of linseed is raised which produces large but relatively few seeds. About 55 percent of the linseed acreage is in these two States. In the Gangetic Basin, which has lighter alluvial soils, a shallow-rooted type is raised. This grows more slowly and produces smaller seeds than the other type, but it yields more per acre. Uttar Pradesh, Bihar, and Rajasthan account for about 36 percent of the total acreage in India.

Profitability Less Than for Wheat.--In the Gangetic Basin, linseed competes for the land with wheat, barley, gram, rapeseed, and mustardseed. Most of the linseed in this area is interplanted with other crops. Fragmentary information indicates that wheat surpasses all of these crops in gross value per acre, and that linseed, rape and mustard seed, gram, and barley all have very roughly the same gross value per acre. In Madhya Pradesh and Bombay, the competition is with wheat, gram, certain millets, and rape and mustard seed. In these States most of the linseed is grown as a pure crop, but there is no information on how profitable it may be relative to other crops.

Long-term trends do not promise any increase in linseed production in India in the next few years, unless linseed benefits from planned irrigation projects. Since much of the linseed oil is used as an edible oil in India (principally in mixtures with other oils), the prospective strong demand for edible oils will be a price-supporting factor for the crop. Export demand for Indian linseed oil depends mainly on supplies forthcoming from the major world exporters of linseed and linseed oil - Canada, the United States, and Argentina.

Castorbeans

Acreage and Production Stable.--Castor acreage in India has remained remarkedly stable for half a century at around 1.3 million to 1.4 million acres. Per acre yields, too, have stayed about the same, at around 200 pounds, over the years. Production in the decade 1950-59 averaged 113,000 long tons compared with 110,000 four decades earlier. India ranks second to Brazil among the world's castorbean producing countries; as in the case of other oilseeds, Indian per acre yields are relatively low.

Castorbeans grow best on well-drained, light, medium, or rich sandy loams. The bulk of the Indian crop, however, is grown on rough ground that will not support other crops. It has a long tap root and is drought resistant. It is also raised in garden plots and as hedges around fields as a wind-break and to help keep animals away from the other crops. About 60 percent of the acreage is in Andhra Pradesh, but because of low yields this State contributes only about half of the production. In northern India, yields may run well over 500 pounds per acre, but in Andhra Pradesh as low as 130 pounds.

Most of the crop is planted as a kharif crop and is harvested from January through February. When planted as a rabi crop, it is harvested from March through April.

Production Not Likely to Increase.--The efforts being made to improve castor varieties and to encourage better cultural practices may result in a slow improvement in per acre yields. On the other hand, it is likely that most of the castor will continue to be planted in small plots and on marginal land. One reason is that pure stands are very susceptible to the ravages of the "semilooper", a caterpillar which can destroy the crop almost overnight.

Most of the Indian crop is exported in the form of castor oil. If world demand for this oil were to increase sharply, it is likely that production in India would respond less rapidly than in countries, such as Brazil and Thailand, which have more readily available idle agricultural land than does India.

Coconuts

Production Increasing Slowly.--India is the third largest producer of coconuts in the world, with an annual harvest of over 4 billion coconuts from 1.6 million acres. From 1948 to 1955 production has increased 30 percent and acreage about 9 percent. On the basis of 6,800 nuts to a long ton, it is calculated that the equivalent of over 600,000 tons of copra are produced annually in India. Production in terms of copra was estimated at 610,000 tons in 1958 and 621,000 tons in 1959. Coconut trees begin to produce when around 7 years old, reach full maturity a few years later, and remain productive for 40 years or more. Coconut production in India apparently is increasing slowly over the years. Most of the best suited areas are already fully planted.

Production of coconuts is concentrated in a narrow strip along the west coast of India, near the southern tip, where there is rainfall nearly every month of the year. About 70 percent of the acreage is in the State of Kerala, about 14 percent is in Mysore, and about 8 percent in Madras. Elsewhere in India there are scattered stands but no large-scale production. Harvesting of coconuts is heaviest during the sunny and relatively dry months from December to May.

In some areas like the Tanjore district in Madras State, high yields per acre are obtained by irrigating and fertilizing. Yields per acre in India are considered to be higher than any of the major producers of coconuts.

A number of plans for increasing coconut production in India have been under way since 1948. Since early 1949 the Central Coconut Committee has had teams in the field to spray the coconut trees three times a year against caterpillars and certain other pests and diseases that considerably reduce the productivity of trees. Up to 1957, this work had been confined to about one-tenth of the coconut acreage in Kerala. Another plan is to make sprayers and spray material available to coconut growers at little or no cost to encourage the spraying of trees at the same time the coconuts are picked.

Still another plan being considered is to make available to coconut producers a special fertilizer mixture at cost and to carry on a campaign for proper fertilization of the trees. Increases of 30 to 40 percent in yields per tree can be obtained in this way, but it takes about 3 years for its full effect.

Government nurseries for growing seedlings from nuts from carefully selected mother trees have been established in recent years at many localities in the coconut growing areas. Seedlings from these nurseries are sold to growers for about 11 U. S. cents each, about half the commercial price for unselected seedlings. A substantial increase in the yields of nuts per tree will result from the use of selected seedlings, but it usually takes about 10 to 12 years for a tree to reach full bearing.

From 1951 to 1956, government nurseries sold 1.6 million trees, equal to 1.5 percent of the total number of coconut trees in India.

Cottonseed Oil

Cottonseed Crushings To Rise.--Most of the cottonseed produced in India is fed to cattle; only a small percentage is crushed for oil. Recently the Indian Government began to encourage cottonseed crushing. One reason why the industry has lagged behind is that special equipment is necessary for delinting the seed before it is crushed. Another reason is that cattle feeders are used to feeding the whole seed and resist a change to feeding meal.

Cottonseed oil production does not depend on the size of the crop, but mainly on the capacity of the cottonseed crushing establishments. In 1958, an estimated 200,000 tons were crushed, less than 10 percent of the crop. Production of the oil amounted to about 24,000 tons. The government hopes to increase cottonseed oil production by 1966 to about 65,000 tons.

Licenses have already been issued for establishing commercial cottonseed crushing units to produce 48,000 tons, and new applications for additional tonnage are being favorably considered. If 85 percent of the cottonseed crops of recent years were crushed, production of cottonseed oil would average about 250,000 tons annually, equal in oil to all of the increase in other oilseeds since Five Year Planning began.

Ghee and Butter

Production Increasing Slowly.--Animal fats contribute about 23 percent to India's total production of fats and oils. Butter and ghee, derived mainly from buffalo milk and to a lesser extent cow's milk, constitute nearly all of the animal fat produced. Ghee is made by heating butter until all the water content is driven off. Like butter in the early days in the United States, ghee is mainly a farm-produced commodity. Production is estimated at around 443,000 long tons for 1958. This puts ghee in second rank in Indian fats and oils production, following peanut oil (900,000 tons). About 84,000 tons of butter (equal to about 68,000 tons of pure fat) is used in India as butter.

Increases in milk production that are resulting from steps to modernize India's dairy industry are going almost entirely to consumers in the form of fluid milk. Ghee is meeting stiff competition from "vanaspati," the Indian name for hydrogenated vegetable oil similar to American shortening. Vanaspati is sold at a much lower price than ghee.

The favorable effects of the cattle improvement and dairy development work which was initiated in the beginning of the Second Five Year Plan are expected to manifest themselves by the end of 1965-66. With the setting up of modern dairies in most of the larger towns and cities, the marketing of fresh milk in surplus producing areas will improve so that ghee production will become more uneconomical. Also increasing vanaspati competition may result in less demand for ghee. Butter production can be expected to increase since many modern dairies will have been completed by 1966, and consumer demand will encourage its increased production. Butter production will most likely account for all of the increase in animal fat production so that ghee and butter production will probably total about 550,000 tons by 1965-66.

TABLE 2.--Vegetable oils: Domestic disappearance and weighted average price of those used mainly for food, 1934-58

Year	Estimated production 1/ 2/	Net trade 2/	Domestic disappearance	Per capita consumption	Weighted average price 3/	Wholesale price index 4/ 1953 = 100	Index of adjusted prices 1953 = 100
	1,000 long tons	1,000 long tons	1,000 long tons	Pounds	Cents per pound		
1934...	1,464	- 287	1,177	7.4	4.11	24	106
1935...	1,102	- 137	965	6.0	5.57	26	132
1936...	1,225	- 294	931	5.7	5.65	25	139
1937...	1,374	- 324	1,050	6.4	5.76	27	132
1938...	1,590	- 455	1,135	6.8	4.62	24	119
1939...	1,456	- 302	1,164	6.9	4.53	27	104
1940...	1,530	- 84	1,446	8.4	4.51	31	90
1941...	1,619	- 113	1,506	8.7	4.43	34	80
1942...	1,308	- 99	1,209	6.9	6.87	41	103
1943...	1,389	- 74	1,315	7.4	12.26	56	135
1944...	1,577	- 62	1,515	8.4	11.79	63	115
1945...	1,552	- 153	1,399	7.7	11.95	64	115
1946...	1,421	- 31	1,390	7.5	16.54	69	148
1947...	1,379	- 53	1,326	8.6	21.31	76	173
1948...	1,370	- 90	1,280	8.2	21.09	93	140
1949...	1,226	- 44	1,182	7.4	22.47	97	143

1950...:	1,256	- 102	1,154	7.2	18.63	101	114
1951...:	1,298	- 91	1,207	7.5	18.97	110	106
1952...:	1,281	- 76	1,205	7.3	13.11	97	83
1953...:	1,253	11	1,264	7.6	16.21	100	100
1954...:	1,388	23	1,411	8.3	12.48	94	82
1955...:	1,658	- 196	1,462	8.5	10.50	87	74
1956...:	1,464	- 15	1,449	8.3	14.96	97	95
1957...:	1,597	64	1,661	9.3	16.08	103	96
1958...:	1,566	39	1,605	8.8	15.78	5/104	94

1/ Production 1934-49, estimated by assuming that a fixed percentage of each crop was crushed, and by using a standard oil yield factor; 1950-58, estimated by method shown in Table 8; includes peanut oil, mustard and rapeseed oil, sesame oil, linseed oil, coconut oil and cottonseed oil beginning 1950.

2/ Minus sign denotes excess of exports over imports. Includes the oil equivalent of oilseeds; from 1950, exports include vanaspati and salad oil.

3/ Based on average annual wholesale prices at the following markets: Peanut, sesame and linseed oils at Bombay; rapeseed oil at Kanpur; and coconut oil at Cochin. Rupee converted to U. S. cents at the official rate of exchange.

4/ 1934-49, General Index of Wholesale Prices, United Nations 1950-58, Index Numbers of Wholesale prices, Office of the Economic Advisor, Ministry of Commerce and Consumer Industry.

5/ January-August average.

Consumption

Consumption Per Person Small but Increasing

Although the estimates of fats and oils consumption in India are necessarily rough, they are adequate to indicate the approximate level of consumption and major year-to-year changes. 3/

In relation to the population, consumption is small. At about 12.5 pounds per person per year, it ranks above the estimates for many of the Southeast Asian countries, but below nearly all other countries. Between 1 and 2 pounds of the 12 is used for soap and other nonfoods, and 10 to 11 pounds go into food. These figures compare with U. S. use of about 20 pounds for nonfood products and 45 pounds for food. This does not take into account the fact that synthetic detergents and other products of the chemical industries in the United States are used in place of soap--other products which would require an additional 10 pounds of fat per person.

In India, edible fats and oils are mainly used for cooking; use as a spread is small. Solid fats, ghee, and vanaspati constitute about 40 percent of the total consumption for food, and liquid oils the other 60 percent.

Consumption of the five major vegetable oils used mainly for food (peanut, rape and mustardseed, sesame, coconut, and linseed) has been steadily increasing. Consumption of these oils has increased from 6.4 pounds per person in 1934-38, to 8.1 pounds in 1944-48, and 8.6 pounds in 1954-58.

There was no trend in consumption in 1934-39, but in 1940 and 1941, with production unusually large and export markets partly cut off by the war, prices in India were low in relation to the general price level and consumption jumped to about 8.5 pounds. Except in 2 years this level was not reached again until 1954. Demand for fats and oils was exceptionally strong from 1943 until about 1950. Japanese occupation of Burma and other Southeast Asian countries in 1942 cut off India's usual sources of rice imports and there was a shortage of food grains. This increased the demand for fats and oils and prices rose substantially.

Since 1950, prices of fats and oils have been lower than prewar compared to other food prices in India. After allowance for changes in the general level of wholesale prices, the wholesale prices of edible oils in India in 1951-58 averaged 91 percent (1953 = 100) compared with 122 in 1934-39. These low prices and an upward trend in national income since the early 1950's were reflected in a rise to about 9 pounds per person in the consumption of the five major oils used mainly for food.

Consumption of Oils Responsive to Prices and Consumer Income

In the United States and most countries of Western Europe, fats and oils are relatively abundant and are low in price in relation both to incomes and to prices of other foods. When incomes rise or when prices fluctuate for fats and oils, consumers do not greatly change the quantity they purchase, although they may shift to some extent from one kind of fat or oil to another. In India, on the other hand, where consumption is low, various statistical indications point to a relatively sensitive response of consumption to changes in both prices and income.

Statistical analysis of annual figures on consumption and prices of edible oils (including vanaspati) in the prewar period and the period since

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3/ The method of estimating consumption is explained in Appendix 2.

1950 indicates that consumers respond to a price increase by a decrease in the quantity purchased in the ratio of about 0.7 to 1. 4/ This means that, with no change in consumer income, total expenditure per person for edible oils and vanaspati tends to rise and fall with price (after allowance for changes in the purchasing power of the rupee), but only about 30 percent as fast. Conditions were so abnormal during the war and until 1950 that the relationship between price and consumption cannot be discovered from the statistics.

It is to be expected that Indian consumers would spend more on fats and oils as their incomes rise. With consumption at a very low level, oils rank high on consumers' preference list, partly because oils are a relatively cheap source of calories. In addition, they make cereal foods more palatable, and cereals are the mainstay of the Indian diet. Special holiday foods in India include fried cakes of wheat or rice flour. Sample surveys of consumer expenditures lead to the conclusion that the "income" elasticity of vegetable oils (including vanaspati) is about 1.0; i.e., consumption varies about proportionally with income. According to a trade source, the income elasticity for solid fats is 1.5 and for liquid oils 0.5. This means, for example, that a 10-percent rise in consumers' income would bring a 15-percent rise in the consumption of solid fats and a 5-percent rise in consumption of liquid oils--assuming prices remain unchanged.

How Oils Are Consumed

Broadly speaking, peanut oil as a liquid oil is more important to southern India than to northern India, but in both areas there is a great deal of mixing of oils. Peanut oil is usually lower priced than other oils and for that reason is mixed with the more preferred oils. Peanut oil is mixed especially around the Bombay and Madras area with sesame oil, and with safflower oil in the Bombay and Andhra Pradesh areas. In northern India it is mixed with rape and mustardseed oil. Linseed oil in the north is also mixed with peanut oil or with rape-mustard oil. The demand for peanut oil increases when supplies of other oils decline. The size of the rape and mustardseed crop has a noticeable effect on the price of peanut oil.

The domestic Indian demand for linseed oil is strongly affected by supplies of rapeseed and peanut oils. In central India, linseed oil is one of the principal edible oils and there is a fairly constant demand for it from year to year. But in northern India, where rape and mustard oils are preferred, linseed oil as well as peanut oil may be mixed with them. The price spread between rape/mustard and linseed oils is the chief factor affecting this use of linseed oil, but the relative price of peanut oil also plays a part.

About 10,000 tons of castor oil is used domestically, mostly as a lubricant, but also for the production of soap, dehydrated castor oil, Turkey red oil, hydraulic brake fluid, toilet goods and hair oils, medicines, and as an illuminant.

Over 60 percent of the coconuts are consumed fresh, grated for curries or otherwise used in cooking. The coconut is an integral part of the diet in the producing areas and its importance as an oil-bearing crop is secondary. About 60 percent of the coconut oil supplies are used for edible purposes and the remainder is used for nonedible purposes, principally soap manufacture.

4/ The data and analysis are shown in Appendix 3.

In the producing areas use is made of coconut oil for hair oil and "oil baths".

Vanaspati Consumption and Production Rising Rapidly

Vanaspati consumption has increased so rapidly and has become such an important source of edible vegetable oil consumption that the industry deserves special mention. Vanaspati is used as a cooking medium all over India, but more especially in the north and, since it is a commercial product, in the towns and cities rather than in the villages.

Production rose from 300 tons in 1930 to 66,000 tons in 1940, 172,000 tons in 1950, and 300,000 tons in 1958. The upward trend in vanaspati production and consumption is likely to continue with rising consumer incomes and increasing urbanization in India. If the average rate of increase in recent years of nearly 10 percent annually continues, the goal of 400,000 tons at the end of the Second Five Year plan in 1960-61 will be achieved.

Vanaspati has probably accounted for a sizable portion of the increase in the estimated total consumption of oils in India since 1951. It has become widely accepted as an alternative fat to ghee, which sells at a much higher price. Vanaspati helps to meet the demand in India for a solid fat for cooking. As in many other countries, the preference for a solid fat over a liquid oil increases from south to north.

The upward trend in vanaspati production is retarded in years when the price rises, but production rises rapidly in years of price decline.

TABLE 3.--Vanaspati: Production, exports and wholesale price and wholesale price of peanut oil, 1950-58

Year	Vanaspati			Price of peanut oil 3/
	Production	Exports 1/	Price 2/	
	1,000 long tons	1,000 long tons	Cents per pound	Cents per pound
1950....	172	---	21.4	17.5
1951....	172	2	23.2	18.5
1952....	190	3	18.9	13.2
1953....	191	1	21.5	17.1
1954....	230	6	16.0	11.9
1955....	260	15	14.2	8.6
1956....	255	10	18.9	13.0
1957....	300	4.2	19.3	14.2
1958....	295	2.6	19.5	14.1

1/ May include some inedible hydrogenated oil.
2/ In 36-lb. tins, Bombay.
3/ Raw, filtered, ex-mill naked, Bombay.

Peanut Oil the Principal Ingredient of Vanaspati

Vanaspati usually is composed of about 90 percent peanut oil, and legislation requires that it contain at least 5 percent sesame oil. Sesame oil can be easily detected by chemical tests, and this helps the food authorities prevent the addition of vanaspati to ghee. In addition to peanut and sesame oils, cottonseed oil has been used in recent years, and occasionally small quantities of coconut and linseed oils. At present the government permits only peanut, cottonseed, and sesame oils to be used.

Until 1958, the use of cottonseed oil had been limited by its small production in India. Also, cottonseed oil was considered inferior to peanut oil for vanaspati manufacture because it has more color and takes longer to hydrogenate. Hence, it could compete with peanut oil for vanaspati only when it sold at a discount. However, following a government request, for the purpose of encouraging cottonseed crushing in India, the vanaspati industry agreed to use 2½ percent of cottonseed oil in the ingredient mix in 1958, and 5 percent in 1959. The tonnage involved in 1958 was about 12,500 long tons.

The difference in price between vanaspati and liquid oil in 1958 was about 5 cents per pound, of which one-third was constituted by a manufacturers' excise tax, about one-third by the cost of packaging, and about one-third by the processing margin.

In addition to vanaspati itself, the vanaspati industry produces from 10,000 to 20,000 tons a year of inedible hydrogenated oil as an ingredient in soap and in sizing for textiles. The production of hardened inedible oil depends mainly on the supplies and prices of competing fats. Imported mutton tallow competes in textiles sizing, and the quantity imported depends principally on the government's policy in granting import licenses. The demand for hydrogenated oils in soap depends on their price in relation to prices of coconut and palm oils.

Exports of hydrogenated oil (including vanaspati) were rather large in some recent years but in 1958 declined to only about 3,000 long tons, less than 1 percent of production. Indian brands of vanaspati in consumer packages have gained a market among Indian communities in such neighboring areas as Persian Gulf ports, Burma, Ceylon, and East Africa.

Soap Consumption Low; Industry Expansion Uncertain

Soap production has expanded rather rapidly in India since 1948. Estimates of present production vary widely, but recent surveys suggest as much as 400,000 tons. This amounts to very little soap per capita, but India hopes to increase soap production substantially in the future. There are now also two detergent plants operating in India.

It has been the policy of the Indian Government to make the cottage soap industry more competitive with factory production. To do this, the government requires factories to pay excise duties on production, while the cottages produce duty free. More than half of the soap production is produced by the cottage industry and the rest by the organized sector.

With soap consumption at about a pound per person per year, there is room for great expansion in the soap industry. On the other hand, the industry is faced with relatively high costs for supplies of fats and oils, which are its principal raw material. The soap industry must compete with edible uses for domestic oils that can be used in soap, or pay high duties on imported oils. Furthermore, animal fats are not used and these are the least expensive soap fats in world trade.

TABLE 4.--Vegetable oils and oilseeds (in terms of oil): Trade by type, average 1910-54, annual 1955-58

Item	Average					1955	1956	1957	1958
	1910-19	1920-29	1930-39	1940-49	1950-54				
EXPORTS	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons
Oilseeds:									
Peanuts (unshelled basis) 1/	321	778	1,235	457	52	46	18	3	4
Mustard and rapeseed	175	157	44	15	(2/)	(2/)	(2/)	(2/)	(2/)
Sesame seed	72	25	6	4	1	3	(2/)	(2/)	(2/)
Flaxseed	326	249	229	81	17	(2/)	(2/)	(2/)	(2/)
Castor beans	95	93	62	24	17	---	---	---	---
Cottonseed	161	131	9	3	---	---	---	---	---
Total oil equivalent 3/	364.9	437.7	483.0	178.3	28.9	14.7	5.2	.9	1.2
Other oilseeds, oil equiv.	4/27.1	7.0	1.0	1.9	7.1	5.3	.2	.1	.1
Total, as oil	392.0	444.7	484.0	180.2	36.0	20.0	5.4	1.0	1.3
Oils:									
Peanut oil	---	.4	5.1	18.1	41.6	162.3	26.4	---	.9
Mustard and rapeseed oil	1.7	1.5	1.1	.5	3.9	.8	.3	.1	.3
Sesame oil	.7	.4	.7	.2	---	3.9	.4	.2	.3
Linseed oil	1.8	.4	.7	6.4	13.8	65.5	44.5	16.7	22.2
Castor oil	5.5	2.2	4.8	5.3	26.0	42.4	42.2	42.4	20.2
Cottonseed oil	---	---	---	---	(5/)	(5/)	(5/)	8.0	2.4
Vanaspati and salad oil	---	---	---	---	2.2	18.6	10.9	4.3	2.7
Other oils	13.8	3.0	1.0	2.4	10.1	25.0	15.6	7.7	6.8
Total	23.5	7.9	13.4	32.9	97.6	318.5	140.3	79.4	55.8
Total exports in terms of oil	415.5	452.6	497.4	213.1	133.6	338.5	145.7	80.4	57.1

IMPORTS									
Oilseeds:									
Copra	10	2	31	42	26	75	87	125	100
Mustard and rapeseed 6/	21	17	12	7	---	---	---	---	---
Flaxseed	8	13	13	6	3	---	---	---	---
Total, oil equivalent	16.4	11.7	28.1	30.9	17.4	47.2	54.8	78.8	63.0
Other oilseeds, oil equiv.	.5	.5	1.0	1.1	2.6	.3	.3	(7/)	(7/)
Total, as oil	16.9	12.2	29.1	32.0	20.0	47.5	55.1	78.8	63.0
Oils:									
Linseed oil	1.1	1.0	.7	.1	(7/)	(7/)	(7/)	(7/)	(7/)
Coconut oil	.4	3.1	26.5	21.2	22.5	22.4	18.8	17.2	7.3
Palm oil	(8/)	(8/)	(8/)	(8/)	(8/)	(8/)	(8/)	18.4	18.3
Other oils	.3	.3	2.7	1.7	11.0	10.8	17.0	.4	.3
Total	1.8	4.4	29.9	23.0	33.5	33.2	35.8	36.0	25.9
Total imports in terms of oil	18.7	16.6	59.0	55.0	53.5	80.7	90.9	114.8	88.9
Net Exports	396.8	436.0	438.4	158.0	80.1	257.8	54.8	9/34.4	9/31.8

1/ Including exports from ports of French India, Portuguese India and Kathiawar (Saurashtra). Converted to unshelled basis; assumed to be mainly kernels /reported separately beginning 1957/.

2/ Less than 500 long tons.

3/ Oil equivalent of oilseeds calculated as follows: Peanuts, 29 percent; mustard and rapeseed, 35 percent; sesame seed, 45 percent; flaxseed, 34 percent; castor beans, 45 percent; and cottonseed, 15.5 percent.

4/ Mostly copra; oil equivalent 63 percent.

5/ Some cottonseed oil exported beginning 1954; not separately classified until 1957.

6/ Including land shipments.

7/ Less than 50 long tons.

8/ Included in other oils; not separately classified until 1957.

9/ Net imports.

India Changing from Net Exporter to Net Importer

Before the Second World War, India was one of the world's leading exporters of fats and oils, including the oil equivalent of oilseeds. Exports in the 1930's totaled nearly 500,000 long tons in terms of oil. Well over half of this consisted of peanuts; linseed and castorbeans were the other major items. Nearly all exports went to Western Europe, particularly the United Kingdom, Germany, and France.

With ocean shipping disrupted during the war, India's exports fell to nearly 200,000 tons. They continued to decline in the postwar period, reflecting the rising domestic consumption of vegetable oils, and reached a low of about 84,000 tons for the three years, 1957 through 1959.

During most of 1950-58, exports of edible oils were deliberately discouraged by the government. In the last 4 years, demand for vegetable oils has been so strong that prices of edible oils in India have been too high most of the time to meet the competition in European markets. The major competition is from West African peanuts and peanut oil, U. S. cottonseed and soybean oils, and occasionally Argentine sunflowerseed oil. India's small exports of edible oils of about 31,000 tons for the 1958 and 1959 average were mainly to Burma and other nearby areas and to Europe. Exports under bilateral agreements as an outlet for edible oils have become important to India.

India's postwar exports of castor oil have averaged about 30,000 tons annually, the same level as the exports (including oil equivalent of castor beans) in the 1930's. Leading markets are the United States, the United Kingdom, and the Soviet Union. India rivals Brazil as the world's leading exporter of this commodity. Postwar exports of linseed oil from India have averaged less than 30,000 tons a year, substantially less than the oil equivalent of the linseed exported before the war. The United Kingdom and Australia are now the principal markets. Increased demand and consumption of linseed oil in India is the principal reason for its decline in exports.

Exports Restricted and Controlled

The Government of India instituted an export licensing system for oils, oilseeds, and oilcakes in 1950. Exporters were granted licenses in accordance with government-announced quotas based mainly on the volume of business done in previous years.

In accordance with a government policy of encouraging the crushing of oilseeds at home, the export quotas for oilseeds were gradually diminished until by 1953 exports of all major oilseeds except peanuts were banned. Relatively small exports of edible-grade peanuts were permitted, but no crushing-grade peanuts were allowed except in 1955 and early 1956.

Until mid-1958, it was government policy to maintain supplies of vegetable oils for consumption in India and to discourage price rises. Under this policy, substantial exports of the major edible vegetable oils were permitted only when the prices of these oils in India were relatively low. An outstanding year was 1955, when production of edible oils rose sharply as a result of unusually good crops of peanuts and rape and mustardseed in 1954-55. Exports totaled 338,000 tons, the most since the early 1940's. Prices of oils and oilseeds rose rapidly during mid-1956, however, and have been relatively high ever since. Exports of edible oils declined in 1957 and 1958 to several thousand tons.

As an exception to the general policy, the government has allowed cottonseed oil to be exported freely since 1955, as a measure to encourage cottonseed crushing. Liberal quotas for exports of safflowerseed, nigerseed, and their oils have also been granted.

Another feature of export policy for oils and oilseeds was the levying of export duties. These were changed from time to time. The main object was to reduce windfall profits that might otherwise have resulted from the wide margins between European and Indian prices when new quotas were announced.

In 1957 and 1958 India's reserves of foreign exchange declined to low levels, largely as a result of heavy imports of industrial equipment and other goods needed from abroad for economic development projects. By mid-1958 the emphasis in government policy for oilseed products shifted toward exporting more as a means of earning foreign exchange. While quotas for oilseed exports were held at low levels, liberal quotas were granted for oils, oilcakes, and oil meal. Exports of oilcake and meal responded quickly, as prices in India were substantially below prices in Europe even after allowance for shipping and other costs. Exports of edible oils, however, were small in 1958, because domestic demand kept prices too high. For example, prices of peanut oil, c.i.f. Europe, from competing sources (South Africa, Communist China, and Nigeria) in the latter half of 1958 averaged 12.04 cents per pound compared with 14.8 cents in Bombay.

In early 1959 the government adopted a scheme of granting additional quotas for peanut oilcake (expeller variety) that were contingent on exporting peanut oil. This resulted in a sharp increase in peanut oil exports from 900 tons in 1958 to 41,340 tons in 1959, as exporters were compelled to export oil if they wanted to export oilcake. In 1959, British West African peanut oil, c.i.f. European ports, was 13.7 cents per pound, 1.5 cents below the price of Indian oil in Bombay.

Imports Restricted

Indian policy restricts imports of oilseeds and oils. There is a duty of 45 percent ad valorem on all vegetable oils, except coconut oil, which is dutiable at the equivalent of 13.5 cents per pound, or more than 100 percent at the prices of most recent years. The import duty on copra is 45 percent ad valorem.

Despite the heavy duties, imports of copra and coconut oil into India have increased over the years and in 1957 reached a peak of about 100,000 long tons in terms of oil. As a measure to help conserve foreign exchange, these imports were reduced moderately in 1958, when only soap manufacturers were allowed to bring in copra and coconut oil, and then only if the oil was for use in soap.

Soapmakers have also brought in palm oil; imports rose steadily in 1957 and 1958 and in 1959 were at a peak of 27,500 tons. Imports of other items have been negligible in recent years.

Oilcake Exports Up Sharply in 1958 and 1959

India was one of the world's largest exporters of cake and meal in prewar days. During most of the postwar period, oilcake exports have been severely restricted to encourage its use as livestock feed or as fertilizer. In 1955, quotas were increased and 170,000 tons were exported. Since the elimination of export duties of about $10.52 per ton and the easing of export restrictions in mid-1958, exports have expanded sharply to a level well above that of prewar days.

Gross imports of oilcake and meal in Europe average over 3 million tons annually. If India were to double the 1958 level of exports, the additional quantity would be equal to about 7 percent of Europe's imports. Since the demand for oilcake and meal in Europe apparently is very elastic, such an increase in supplies would exert only a slight downward pressure on prices. Additional exports of this magnitude from India, however, would probably result in a material increase in prices of oilcakes in India.

Outlook

Production Expected Only To Keep Up with Population Increase

Production of vegetable oils in India is expected to continue to increase and, if the trends of the past decade continue, production by 1966, the end of the Third Five Year Plan, would be about 37 percent above the 1957-58 average. However, because India's population is expanding rapidly, this substantial increase in supply would do no more than slightly increase the present low per capita level of total consumption of fats and oils, including ghee. India's trade position would be about the same as it is now--it would have a small net import balance. Imports probably would consist mainly of coconut oil for use in soap. Exports would consist mainly of castor and linseed oils.

The indicated production of vegetable oils in 1966 is based upon an output of 8.35 million tons of oilseeds, or nearly 37 percent more than in 1957-58. The increase would mostly reflect expanded acreage of peanuts and to a lesser extent more land put in rape and mustardseed as well as increases in yields per acre. Some allowance has been made for higher output of coconut, cottonseed, and miscellaneous oils. As indicated in Appendix 4, allowance has been made for slight increases in yields of the major oilseeds--peanuts, rape and mustardseed, and sesame. Efforts are being made to increase yields through the use of irrigation projects, improved seed, fertilizers, and improved cultural practices. Unfortunately, the obstacles to higher yields are great. Illiteracy and poverty hinder the adoption of better techniques and fertilizers. Also, other crops, such as cotton, rice, sugar, and tea, have priority on India's limited supply of fertilizer. In addition, the soil has been badly depleted.

What the Red Queen said to Alice about the need to run as fast as one could on the treadmill just to stay in the same place, can be said about the oilseed situation in India. India has to run rapidly just to maintain its present position because of the increasing number of mouths to be fed. Its population is expanding at the rate of 8 million per year, and by 1961 this rate is expected to rise to 10 million. Consequently, by 1966 India will have a population of almost 480 million people. This would be about 80 million, or 19 percent, more than in 1958. The consumption estimate in table 5 of 13.6 pounds per person in 1966 is slightly higher than the 1957-58 average. Any attempt to increase per capita consumption beyond this would require a considerable increase in supply. Since this is not likely to come from production it would mean that India's imports would have to go up sharply.

Consumption of vegetable oils tends to increase with an expansion in income. An increase of 10 percent in income per person probably would be

TABLE 5.--Fats and oils: Expected consumption in 1966 compared with the 1957-58 average

Period	Population	Consumption per capita	Domestic consumption of fats and oils	Trade			Production		
				Imports	Exports	Net imports	Vegetable oils	Ghee and butter	Total
	Millions	Pounds	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons
1957-58..	399	12.5	2,234	100	68	32	1,680	522	2,202
1966..	480	13.6	2,908	100	50	50	1/2,303	550	2,858

1/ Based on production figures of Appendix 4, table 10, 11 and 12.

reflected in a 10 percent rise in per capita consumption of oil, or about 1.3 pounds. Such an increase by 1965-66 would absorb an additional 280,000 tons of oil, assuming that oil prices held the same relationship to the general price level as they did in 1957-58. If the oil were not available, then the rise in per capita income would be reflected in higher prices for vegetable oils. Also, additional upward pressure on oil prices may come about because food grains may be in short supply. The experience of the war years indicates that a small supply of food grains increases the demand for vegetable oils.

Indian Edible Oil Exports Likely To Be Small

It appears that little edible oil will be available for export from India in the near future. The demand for oils in India probably will keep prices in that country too high to be able to compete in foreign markets. Only in years of exceptionally high production will India be able to export edible oils. However, as in 1958 and 1959, foreign exchange considerations may lead the government to take measures making exports of vegetable oils profitable even when market price relationships are unfavorable.

Castor oil exports probably will average somewhat smaller than in the 1950's, though larger than 1958 when production was down sharply. As industry develops in India the demand for the domestic use of this oil probably will gradually increase, so that eventually exports may decline from former levels.

Linseed oil exports are likely to be very irregular and will probably become less important in the future. The demand for linseed oil for edible purposes will probably keep the price too high much of the time to be competitive in world markets with supplies from other countries.

Oilcake and Meal Exports Likely To Continue High

The sharp rise in oilcake exports in 1958 and 1959 when some restrictions were eliminated illustrates the possibility of large exports in the future. Even with exports at 1959 levels, prices in India were substantially below the competitive level in Europe, the world's largest import market for oilcake and meal. For example, in January 1959, peanut oilcake (expeller type) was selling for around $110 per long ton in European ports, but at about $65 in Bombay. Shipping and other charges between Europe and Bombay are much less than the difference between these two prices. This wide margin indicates that larger quantities could have been exported if permitted by government policy.

Under the restrictive export policies of recent years, prices of oilcake in India have been far below the level at which they would be competitive in the European market. Without export restrictions these exports would rise to levels above those of 1959.

TABLE 6.--Oilcake and meal: Estimated total production and exports selected averages 1935-54, annual 1955-59

Period	Production	Exports
	1,000 long tons	1,000 long tons
Average:		
1935-39	1,667	348.0
1945-49	2,244	2.2
1950-54	2,299	7.0
Annual:		
1955	2,881	170.7
1956	2,645	56.0
1957	2,875	77.8
1958	2,770	234.9
1959	3,017	519.1

Appendix

1. Effect of Price on Peanut Acreage

The effect on peanut acreage from changes in peanut prices in relation to prices of jowar (grain sorghum) and bajra (spiked millet) was investigated by correlation analysis. The basic data for the analysis are shown in table 7.

The Indian Government has published all-India harvest prices of peanuts, jowar, and bajra as index numbers for the crop years 1938-39 to 1955-56. These index number series have been extended backward for this correlation to 1928-29, on the basis of harvest prices of jowar and bajra in the State of Bombay and Madras and of wholesale prices of peanuts at the cities of Bombay and Madras in October-February of each crop year (table 8). These are the months when most of the peanut crop is marketed. The index numbers for peanut prices have been brought forward to 1958-59 on the basis of wholesale prices at Bombay and Madras, but this could not be done for jowar and bajra.

Annual estimates of peanut acreage are available for the whole period, annual estimates for jowar and bajra began in 1944.

TABLE 7.--Peanuts, jowar and bajra: Acreage and harvest prices, crop years ending 1929-59

Year	Acreage			Index of harvest prices (1938-39 = 100) 1/				Price ratio
	Peanuts	Jowar	Bajra	Peanuts	Jowar	Bajra	Average jowar & bajra	peanuts to jowar & bajra
	1,000 acres	1,000 acres	1,000 acres					
1929..	6,149	---	---	219	162	172	167	131
1930..	5,793	---	---	194	158	172	165	118
1931..	6,330	---	---	113	100	115	108	105
1932..	5,378	---	---	142	87	87	87	163
1933..	6,935	---	---	131	99	99	94	139
1934..	7,662	---	---	87	84	91	88	99
1935..	5,245	---	---	132	102	100	101	131
1936..	5,365	---	---	142	96	98	97	146
1937..	6,998	---	---	152	111	108	109	139
1938..	9,178	2/36,955	2/17,247	113	99	103	101	112
1939..	8,827	---	---	100	100	100	100	100
1940..	8,560	---	---	126	122	126	124	102
1941..	8,912	---	---	91	106	115	110	83
1942..	7,070	---	---	131	135	135	135	97
1943..	7,697	---	---	246	246	225	235	105
1944..	9,808	38,239	21,501	305	374	335	354	86
1945..	10,576	40,604	24,286	262	318	305	311	84
1946..	10,276	38,512	23,119	341	302	308	305	112
1947..	10,267	38,939	21,557	351	323	339	331	106
1948..	10,079	36,259	20,806	548	401	353	377	145
1949..	9,165	36,829	19,783	559	457	512	484	115
1950..	9,832	38,335	22,881	660	460	460	460	143
1951..	11,106	38,447	22,296	784	429	370	399	196
1952..	12,151	39,399	23,522	669	386	374	380	176
1953..	11,848	43,340	26,613	584	426	403	414	141
1954..	10,495	43,882	30,145	630	417	398	407	155
1955..	13,693	43,446	27,983	370	250	261	255	145
1956..	12,685	42,904	28,024	444	310	376	343	129
1957..	13,450	40,367	27,884	573	(3/)	(3/)	(3/)	(3/)
1958..	14,876	41,411	27,453	545	(3/)	(3/)	(3/)	(3/)
1959..	14,481	42,162	27,906	609	(3/)	(3/)	(3/)	(3/)

1/ All-India harvest prices, 1938 to 1956; all other years calculated from simple averages of Bombay and Madras prices shown in table 7-A.

2/ Average 1936-37/1938-39. 3/ Not available.

Agricultural Situation in India; Farm (Harvest) Prices of Principal Crops.

TABLE 8.--Peanuts, jowar, and bajra: Wholesale prices of peanuts at Bombay and Madras, averages for marketing season 1929-59 1/ and harvest prices of jowar and bajra, 1929-54

Year	Peanuts		Jowar		Bajra	
	Bombay City	Madras City	Bombay State	Madras State	Bombay State	Madras State
	Rupees per long ton	Rupees per long ton	Rupees per long ton	Rupees per long ton	Rupees per long ton	Rupees per long ton
1929....	223.3	248.2	120.8	114.0	139.5	129.3
1930....	202.0	215.7	129.3	98.7	153.1	115.7
1931....	121.3	123.1	76.6	68.1	91.9	88.5
1932....	158.9	146.9	59.6	66.4	66.4	69.8
1933....	140.8	140.9	69.8	59.6	83.4	71.5
1934....	96.2	91.7	68.1	52.8	79.9	62.9
1935....	146.7	139.0	74.9	73.2	85.1	71.5
1936....	154.2	151.7	71.5	68.1	78.3	74.9
1937....	167.4	161.5	86.8	73.2	96.9	71.5
1938....	122.1	120.8	76.6	66.4	93.6	68.1
1939....	108.5	107.2	71.5	73.2	85.1	71.5
1940....	148.7	134.2	95.3	78.3	100.6	85.1
1941....	108.2	93.7	78.3	74.9	86.8	78.3
1942....	161.9	133.0	90.2	88.5	93.6	88.5
1943....	280.3	244.4	185.5	159.9	199.1	154.8
1944....	327.1	318.1	306.3	212.7	284.2	231.4
1945....	280.8	267.8	234.8	197.4	251.8	211.0
1946....	359.9	343.3	267.1	197.4	263.7	207.6
1947....	452.0	402.6	272.2	202.5	262.0	202.5
1948....	621.5	570.8	294.4	262.0	335.2	236.5
1949....	689.3	616.6	420.3	260.3	430.5	449.2
1950....	780.0	713.5	265.4	221.2	321.6	222.9
1951....	876.6	889.4	292.7	219.5	321.6	222.9
1952....	757.9	761.7	299.5	219.5	326.7	228.0
1953....	680.6	691.2	326.7	214.4	326.7	222.9
1954....	674.1	653.9	340.3	256.9	353.9	272.2
1955....	445.9	434.5	(2/)	(2/)	(2/)	(2/)
1956....	517.3	490.3	(2/)	(2/)	(2/)	(2/)
1957....	647.9	683.3	(2/)	(2/)	(2/)	(2/)
1958....	638.9	627.2	(2/)	(2/)	(2/)	(2/)
1959....	704.8	711.1	(2/)	(2/)	(2/)	(2/)

1/ Peanut marketing season average price, October-February; season ending in year shown.

2/ Not available.

Agricultural Prices in India

In accordance with a method of analysis developed by Nerlove 1/, peanut acreage in a given year was correlated with peanut acreage the preceding year, with the preceding year's ratio between the price of peanuts and the price of jowar and bajra, and with time (the "trend variable"). This analysis gave statistically significant results for the year 1929-30 to 1942-43. 2/ The relationship appeared to be the following: (1) Acreage in any given year tended to return 20 percent of the way from the preceding year's acreage toward the average; (this is the net relationship, after allowing for the effect of the other two factors). (2) There was a net upward trend during the period of 173,000 acres a year (about 2.5 percent per year). (3) Acreage also varied in accordance with the ratio between peanut and jowar-bajra prices; at the average of the ratio for the period (117), the elasticity of the response was 0.8. That is, a 1 percent increase in the ratio would be followed the next year by an 0.8 percent increase in peanut acreage.

The relationship between price and acreage broke down for several years after 1942-43. Prices of food grains, including the millets, were controlled in many cities and States of India. Rationing of food grains was widespread. Grow-More-Food campaigns emphasized food grains, and there were attempts to discourage plantings of other crops. Peanut acreage nevertheless rose to a new high in 1943-44 and again the following year, but it declined in most of the following years until it spurted ahead once more in 1950-51 to a new record.

The years since 1950-51 are too few to serve as a basis for a trustworthy statistical analysis. In the absence of price data for jowar and bajra after 1956-57, only 7 years can be used. Application of the same method as for the 1929-30/1942-43 period does suggest that the acreage in the recent 7 years was affected mainly by trend and the price ratio, but statistically significant results were not obtained. 2/

1/ Marc Nerlove, The Dynamics of Supply, Johns Hopkins Press, 1958.

2/ The following equation was derived by the least-squares criterion, for the period 1929-30/1942-43:

$$X_1 = -5,743 + .81\ X_2 + 50\ X_3 + 173\ X_4$$

where X_1 = acreage in a given year (in thousands of acres)

X_2 = acreage the preceding year (in thousands of acres)

X_3 = ratio the preceding year between the price of peanuts and the price of jowar and bajra (index number; for the method of calculation see table 7)

X_4 = the given year (1929-30 = 1, 1930-31 = 2, etc.)

For the period 1950-51/1956-57, the following equation was derived:

$$X_1 = 11{,}450 - .60\ X_2 + 30\ X_3 +- 190\ X_4$$

Statistical coefficients for the 1929-30/1942-43 period:

$$R^2 1.234 = .77$$

$$R 1.234 = .877$$

Coefficient	Subscripts		
	12.34	13.24	14.23
r	.53	.59	.40
b	.81	50	173
σ_b	.18	10	51
t_b	4.38	4.96	3.40
P_b	.002	< .001	.007

Statistical coefficients for the 1950-51/1956-57 period:

$$R_1^2 .234 = .76$$

$$R 1.234 = .87$$

Coefficient	Subscripts		
	12.34	13.24	14.23
r	.47	.49	.75
b	-.60	30	790
σ_b	.37	18	268
t_b	1.64	1.69	2.95
P_b	.2	.2	.10

Note: The value for the trend variable, b 14.23, appears to be much too high, as the simple linear trend for a roughly similar period is + 488 (see table 12). The negative regression on the preceding year's acreage, b 12.34, is suspect because it would mean a reversal of farmers' behavior from the earlier period, for which we have a statistically significant regression coefficient that is positive.

2. How The Consumption Estimates Are Calculated

Production of vegetable oils in India is not reported; neither are stocks or sales. Estimates of consumption of oils must be built up from reports and estimates of oilseed production and utilization. Table 9 shows how Indian fats and oils consumption was calculated in 1958. The oilseed production and utilization figures refer to the 1957-58 crops; all other data are for the calendar year 1958.

Estimates of the consumption of peanut oil, rape and mustardseed oil, sesame oil, linseed oil, castor oil, and coconut oil start with reported production of the corresponding oilseed. Imports, if any, are added, and exports, seed use, edible uses, and any other noncrushing uses are deducted. The remainder is the estimated quantity of seed that is crushed for oil. A factor representing the industrywide outturn of oil per ton of oilseed crushed is then applied, to obtain an estimate of the quantity of oil produced. This estimate is adjusted for imports and exports. The remainder represents the quantity available for consumption in India.

Use for seed is calculated by applying the estimated seeding rate per acre to the acreage of the crop the following year. Edible uses of oilseeds are very rough estimates, usually based on marketing surveys made at long intervals. Import and export data are relatively accurate.

Production of cottonseed oil is estimated directly from crushing capacity. Through the program to increase cottonseed crushing, the government and the oilseed trade have a fairly accurate idea of the production of cottonseed oil in recent years.

Since the various oilseed crops are harvested at different times of the year, production years differ for the various vegetable oils. A common year for all vegetable oils can be roughly approximated, however, by assigning oil production to the calendar year following the year in which the major plantings of the oilseed crop were made. For example, the main 1957-58 peanut crop was planted in April-May 1957, and harvested in the autumn. By the time it had moved to crushers, most of the crushings and oil production took place in 1958. The second rabi 1957-58 crop of peanuts was harvested in the spring of 1958 and crushed in the same calendar year. Linseed and rape and mustardseed being winter crops were planted in the fall of 1957, harvested in the spring of 1958, and crushed mainly in 1958.

There are no data on stocks of fats and oils in India. Published trade comments and the record of price movements suggest, however, that wide stock fluctuations do often occur from the beginning of one marketing year to the beginning of the next. The lack of an adjustment for stock changes probably introduces a considerable error into the consumption estimates for some years. Nevertheless, since a flow into stocks in a particular year is almost certain to be followed by an offsetting flow out of stocks in a subsequent year or years, an average of several years is probably a good measure of the level of consumption, and particularly of the level in relation to an earlier or later period of years.

3. Relationship Between Consumption and Price

Table 2 shows estimated consumption per person in India of the five leading vegetable oils used for food, and an index of the deflated wholesale price of these oils. (This price is calculated for each year by multiplying consumption of each oil by its average wholesale price at a leading market, TABLE 9.--Fats, oils and oilseeds: Estimated supply and disposition, 1958

Item	Oilseed						Oil				
	Production	Imports	Used for seed	Edible and other non-crushing uses	Exports	Crushed	Production	Imports	Exports	Use: Edible	Use: Non-edible
	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons
Ghee and butter (fat content)......	---	---	---	---	---	---	464	---	---	464	---
Peanuts (in-the-shell basis)	4,436	---	679	333	4	3,420	966.6	---	0.9	902.8	62.9
Mustard and rapeseed.	923	---	17	100	([1])	806	265.8	---	0.3	265.5	---
Sesame seed..........	354	---	14	71	([1])	269	102.2	---	0.3	81.9	20.0
Linseed..............	249	---	29	17	([1])	203	69.0	---	22.2	31.8	15.0
Coconuts (copra basis)	632	100	11	400	---	321	197.4	[2]7.3	---	101.1	103.6
Castor beans.........	89	---	3	---	---	86	33.7	---	20.2	---	13.5
Cottonseed...........	2,225	---	135	1,890	---	200	24.0	---	2.4	15.0	6.6
Other oilseeds.......	200	---	3	3	([1])	194	48.5	[3]18.6	6.8	27.0	33.3
Total...............	---	---	---	---	---	---	2,171.2	25.9	53.1	1,889.1	254.9

[1] Less than 500 long tons.
[2] Imports prohibited April-September 1958.
[3] Includes 18,300 long tons of palm oil.

Prepared or estimated from official statistics (Estimates of Area and Production of Principal Crops in India; Indian Agricultural Statistics; Oilseeds in India; Agricultural Marketing in India (series includes Report on the Marketing of Linseed. No. 8 and 89; - Groundnuts, No. 28 and 73; - Coconuts and Coconut Products, No. 46; - Castor Seed, No. 55; - Rapeseed and Mustard, No. 60; - Sesame and Nigerseed, No. 72); Monthly Statistics of the Production of Selected Industries of India; Report of the Panel on Oils and Soaps; and Monthly Statistics of the Foreign Trade of India); reports of agricultural attaches and other U. S. representatives abroad and other information.

NOTES: TABLE 9.--Fats, oils and oilseeds: Estimated supply and disposition, 1958

Peanuts: Seed use, 70 pounds per acre; edible use estimated at 7.5 percent of production.
Peanut oil: Production, 28 percent of nuts crushed; edible use calculated as a residual (includes oil hydrogenated for vanaspati as well as oil consumed in liquid form); non-edible use, 55 percent of soap production.

Rape and mustard seed: Seed use, 6 pounds per acre; edible use (as condiment), estimated.
Rape and mustard seed oil: Production, 33 percent of seeds crushed.

Sesame seed: Seed use, 6 pounds per acre; edible use, estimated at 20 percent of production.
Sesame oil: Production, 38 percent of seed crushed; edible use calculated as a residual (includes oil hydrogenated for vanaspati); non-edible use, estimated.

Linseed: Seed use, 15 pounds per acre; edible and other non-crushing uses, 7 percent of production.
Linseed oil: Production, 34 percent of seed crushed; edible use calculated as a residual; non-edible use, estimated.

Coconuts (copra basis): Copra production calculated on the basis of 6,800 nuts per ton of copra; seed use estimated; edible and other non-crushing uses calculated as a residual; crushings, 35 percent of copra production plus 100 percent of imports.
Coconut oil: Production, 61½ percent of copra crushed; edible use calculated as a residual; non-edible use, 25 percent of soap production in organized factories plus 25 thousand tons for "cottage industries" and 50 thousand tons for toilet preparations and other uses.

Castorbeans: Seed use, 5 pounds per acre.
Castor oil: Production, 39 percent of beans crushed.

Cottonseed: Seed use, 15 pounds per acre; other non-crushing uses, mainly for cattle feed, calculated as a residual; crushings estimated.
Cottonseed oil: Production, 12 percent of seed crushed; edible use, 5 percent of vanaspati production; non-edible use calculated as a residual.

Other oilseeds: Production estimate includes nigerseed safflowerseed, and mowra seed, which together constitute 85 percent of the estimate, and tobacco seed, poppy seed, neemseed, pomgamseed and other minor oilseeds available for commercial utilization; seed use, and edible and other non-crushing uses, estimated.
Other oils: Production: Except for mowra, niger and safflower, all other oilseeds are mostly crushed by ghanis and an average oil yield of 25 percent has been taken for calculation purposes. An estimated 7 thousand tons of oil extracted from cake and meal are also included. Edible use, calculated as a residual; non-edible use includes estimates of neem and mowra oils used for soap and burning, and oil from cake and meal.

dividing the sum of these products by total consumption of the five oils, and then dividing by the index of wholesale prices of all commodities in India. Finally, the deflated prices obtained in this way are converted to index numbers with 1953=100.)

There was a high correlation in the period 1934-42 between consumption and price, as measured by these estimates. A simple mathematical correlation, assuming a linear relationship, gave a correlation coefficient of 0.95. 3/ The indicated elasticity of demand with respect to price, at the average price and consumption for the period, was 0.75.

The prewar relationship failed to hold in 1943-50. Consumption was much larger in the war and early postwar years than would be expected with the high prices that prevailed. It is probable that scarcity of food grains was a major reason for the increased demand for food oils.

In the years since 1950, consumption and price appear to have been related to each other in about the same way as before the war. There is one striking new feature, however, in the behavior of the consumption estimates. In years when the general wholesale price level increased, the estimated consumption of oils was larger than would be expected on the basis of the relationship with price; and when the general wholesale price level declined, the estimated consumption was smaller than would be expected. As explained in the preceding section of the Appendix, the consumption estimates have not been adjusted for changes in stocks of oils in India. A rise in stocks in a given year would make the estimate of consumption larger than actual consumption, while a fall in stocks would result in an underestimate of consumption. It may well be that rising general prices in India lead to hoarding of storable commodities, including oilseeds and oils, because of the expectation of higher prices and that falling prices induce dishoarding. At least, such a tendency would be consistent with the behavior of the consumption estimates.

3/ The regression equations are:

Period 1934-43: $X_1 = 12.30 - .047X_2$

Period 1951-58: $X_1 = 13.68 - .059X_2 + .094X_3$

where X_1 = consumption, in pounds per person
X_2 = average wholesale price of vegetable oils, deflated by index of general wholesale prices and converted to index numbers (1953=100)
X_3 = no. of points change from preceding year in index of general wholesale price index.

When the same relationships were calculated using logarithms instead of natural numbers, the results were:

Period 1934-42: $\text{Log } X_1 = 2.31860 - .72305 \text{ Log } X_2$

Period 1951-58: $\text{Log } X_1 = -.03427 - .64472 \text{ Log } X_2 + 1.10765 \text{ Log } X_3$

Each of these regressions (two arithmetic and two logarithmic) falls well within the range of the standard error of the function of each of the others. The demand elasticities estimated by the log curves (.72 and .64) are very close to the elasticities at the means of the corresponding linear regressions.

Statistical coefficients for the 1934-42 period:

$$r^2\ 12 = .898$$
$$r\ \ 12 = .947$$

Coefficient	Equations	
	Natural numbers	Logs
b_{12}	- .047	- .72
σb_{12}	.0076	.08
$t\ \ b_{12}$	6.2	8.9
$P\ \ b_{12}$	$< .001$	$< .001$

Statistical coefficients for the 1951-58 period:

$$r^2\ 1.23 = .537$$
$$r\ \ 1.23 = .733$$

	Equation in natural numbers subscripts		Equation in logs subscripts	
	12.3	13.2	12.3	13.2
b	- .059	.094	- .64	1.11
σ b	.029	.040	.32	.50
t b	2.0	2.3	2.0	2.2
P b	.1	$< .1$	.1	$< .1$

A mathematical correlation for the years 1951-58, using linear relationships, was run to test the relationship of consumption to the price of oils and to change in the general wholesale price level. This analysis gave a multiple correlation coefficient of 0.73, a partial correlation of 0.68 between consumption and price, and a partial correlation of 0.72 between consumption and change in the wholesale price level. 3/ The relationship between consumption and price (as indicated by the regression line) was almost the same as that indicated by the analysis for 1934-42. Elasticity of demand, at the average price and consumption for the period, was 0.65.

Annual estimates of national income in India show a slight upward trend since 1950 in income per person, with relatively large year-to-year changes. Since so much of India's economy depends on agriculture, variations in crop yields are a major factor in fluctuations in national income. There is no apparent correlation between the year-to-year fluctuations in income and in consumption of vegetable oils. However, both consumption and income per person averaged higher in the late 1950's than at the beginning of the decade. This suggests an income effect on vegetable oil consumption, but the effect cannot be determined from the brief time series.

4. Forecasts of Oilseed Production

The forecasts of oilseed production for 1965-66 are based primarily on straight line trends fitted mathematically to data on acreage and yields per acre, respectively, of each of the five major oilseeds for the 10 years, 1949-50 to 1958-59. It was assumed that these trends would continue through 1965-66. Forecasts of production were made by multiplying the projected acreages by the projected yields per acre.

An important new development in India, namely, river valley irrigation schemes, initiated in 1958, and which could not be measured statistically in trend line projections, is expected to have an important influence in oilseed production. Large areas under oilseeds, especially peanuts, are likely to come under irrigation. The effect of irrigation will most likely increase the level of yields per acre over what was anticipated by straight line trend projections. Yields per acre have therefore been revised upward and acreage taken at about the same level as the trend projections (table 10).

The prediction is that oilseed production will continue to increase at an accelerating pace. With average growing conditions, production of the five major oilseeds will total about 8.4 million tons in 1965-66, 500,000 tons more than what is indicated by the trend projection. Production in any given year could depart widely from the trend as a result of variations in growing conditions. Table 13 shows how wide the year-to-year changes in production were in the 1950's. The yield per acre projections for 1966 have been raised by only a small amount in anticipation of the effects of the river valley irrigation projects.

The trends in yields per acre have been slight. If the total efforts being made in India to increase yields per acre succeed to some measure, the effect on production will be significant and production forecasts shown here may have to be correspondingly increased.

A summary of the related statistics used for trends is shown in table 13, the last column shows the production forcasts for 1965-66.

TABLE 10.--Five major oilseeds: Trend and estimated projections, crop year ending 1966

Item	Linear trend for 1966 1/	Estimated projections
ACREAGE	1,000 acres	1,000 acres
Peanuts	18,069	18,100
Mustard and rapeseed	7,513	7,600
Sesame	5,511	5,600
Linseed	3,656	3,700
Castor	2/ 1,300	1,300
Total	36,049	36,300
YIELD PER ACRE	Pounds	Pounds
Peanuts	715	743
Mustard and rapeseed	361	383
Sesame	187	200
Linseed	212	257
Castor	210	215
PRODUCTION	1,000 long tons	1,000 long tons
Peanuts	5,768	6,000
Mustard and rapeseed	1,212	1,300
Sesame	460	500
Linseed	346	425
Castor	122	125
Total	7,908	8,350

1/ Taken from Table 13.

2/ Trend below these figures were not accepted and values near the average of recent years were used instead.

TABLE 11.--Fats and oils: Projected per capita consumption from domestic production and imports, crop year ending 1966

Item	Seed	Oil [1]
PRODUCTION	1,000 long tons	1,000 long tons
Peanuts	6,000	1,328
Mustard and rapeseed	1,300	373
Sesame	500	148
Linseed	425	118
Castor	125	53
Cottonseed oil		60
Coconut oil		165
Misc. and oil from cake		63
Net imports		50
Ghee and butter		550
Total, all fats		2,908
	Pounds	
Consumption per capita [2]	13.6	

[1] Using the following conversion rates: Peanuts, 54 percent of the oilseeds crushed for oil, 40 percent oil yield; mustard and rapeseed, 87 percent of the oilseeds crushed for oil, 33 percent oil yield; sesame, 78 percent of the oilseeds crushed for oil, 38 percent oil yield; linseed, 87 percent of the oilseeds crushed for oil, 34 percent oil yield; castor, 90 percent of the oilseeds crushed for oil, 39 percent oil yield. In addition to production estimates of other oils, net imports and ghee and butter production are estimated.

[2] Based on population of 480 million.

TABLE 12.--Five major annual oilcrops: Trends in acreage and yield per acre, crop year ending 1950-59

Crop	10-year average 1950-59	Average annual increase or decrease (Trend) 1/	Standard error of the trend 2/	Is the trend significantly different from zero? 2/
ACREAGE	1,000 acres	1,000 acres	1,000 acres	
Peanuts	12,462	488	95	Yes
Mustard and rapeseed	5,750	153.3	288.0	No
Sesame seed	5,677	-14	56	No
Linseed	3,566	7.9	281.2	No
Castor beans	1,350	-22	7.9	Probably
YIELD PER ACRE	Pounds	Pounds	Pounds	
Peanuts	677	3.3	8.0	No
Mustard and rapeseed	353	0.7	74.3	No
Sesame seed	184	0.3	1.9	No
Linseed	234	-1.9	23.7	No
Castor beans	184	2.3	.8	Probably

1/ Determined by fitting a least-squares trend line to the data in Table 10. Minus sign denotes decrease.

2/ According to statistical theory, if the trend is three times or more as large as its standard error it is definitely significant; if it is two to three times its standard error it is probably significant; if below two items, its significance is dubious. If the trend is smaller than its standard error it is definitely considered to be not significantly different from zero. As applied to this table, this means that the data do not indicate any significant trend, either upward or downward, in linseed and sesame acreage or in yields per acre of peanuts, rape and mustard seed, sesame seed, or linseed.

TABLE 13.--Five major oilseeds: Acreage, yield per acre, and production, crop year ending 1950-59, and forecast for 1966

Oilseed	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	Estimated projections 1965-66
	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
ACREAGE	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres
Peanuts	9,832	11,106	12,151	11,848	10,495	13,693	12,685	13,450	14,876	14,481	18,100
Mustard and rapeseed	4,781	5,118	5,934	5,201	5,545	6,027	6,316	6,311	5,979	6,288	7,600
Sesame seed	5,055	5,445	5,942	5,874	6,351	6,490	5,667	5,446	5,171	5,332	5,600
Linseed	3,818	3,503	3,409	3,366	3,428	3,362	3,781	4,154	3,129	3,708	3,700
Castor beans	1,458	1,372	1,437	1,326	1,346	1,370	1,405	1,415	1,184	1,193	1,300
Total	24,944	26,544	28,873	27,615	27,165	30,942	29,854	30,776	30,339	31,002	36,300
YIELD PER ACRE	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Peanuts	770	691	579	545	724	675	671	699	668	745	743
Mustard and rapeseed	372	328	350	363	347	379	300	364	346	381	383
Sesame seed	191	180	168	177	195	205	182	182	153	207	200
Linseed	246	235	216	244	248	256	245	207	178	260	257
Castor beans	197	165	165	172	171	199	198	196	168	208	215
PRODUCTION	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons	1,000 long tons
Peanuts (unshelled)	3,379	3,426	3,142	2,883	3,391	4,128	3,801	4,200	4,436	4,816	6,000
Mustard and rapeseed	793	750	928	844	858	1,021	846	1,026	923	1,069	1,300
Sesame seed	431	438	445	464	554	593	460	442	354	493	500
Linseed	420	368	328	366	379	384	414	384	249	430	425
Castor beans	128	101	106	102	103	122	124	124	89	111	125
Total	5,151	5,083	4,949	4,659	5,285	6,248	5,645	6,176	6,051	6,919	8,350

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